induced assembly of planar aggregates; the patterning of the electrolyte/silicon oxide/silicon interface to exert spatial control over the assembly process; and the real-time control of the assembly process via external illumination. The present invention provides a set of fundamental operations enabling interactive control over the creation and placement of planar arrays of several types of particles and biomolecules and the manipulation of array shape and size. The present invention enables sample preparation and handling for diagnostic assays and biochemical analysis in array format, and the functional integration of these operations. In addition, the present invention provides a procedure for the creation of material surfaces with desired properties and for the fabrication of surface mounted optical components. The invention is also for a system and method for progammable illumination pattern generation, including a novel method and apparatus to gennerate patterns of illumination and project them onto planar surfaces or onto planar interfaces such as the interface formed by an electrolyte-insulator-semiconductor (EIS), e.g., as described herein. This enables the creation of patterns or sequences of patterns using graphical design or drawing software on a personal computer and the projection of said patterns, or sequences of patterns ("time-varying patterns"), onto the interface using a liquid crystal display (LCD) panel and an optical design which images the LCD panel onto the surface of interest. The use of the LCD technology provides flexibility and control over spatial layout, temporal sequences and intensities ("gray scales") of illumination patterns. The latter capability permits the creation of patterns with abruptly changing light intensities or patterns with gradually changing intensity profiles.

An apparatus providing programmable illumination pattern generation for the manipulation of colloidal particulates and biomolecules in suspension between electrodes, is disclosed. The apparatus implements LEAPS (Light-controlled electrokinetic assembly of particles near surfaces), which relies on: AC electric field-induced assembly of particles the patterning of the electrolyte/silicon oxide/silicon interface to exert spatial control over the assembly process; and the real-time control of the assembly process via external illumination. The apparatus generates patterns of illumination and projects them onto planar surfaces, *i.e.*, a LEAPS electrode. This enables the creation of patterns using graphical design or drawing software on a personal computer and the projection of said patterns, or sequences of patterns ("time-varying patterns"), onto the interface using a liquid crystal display (LCD) panel and an optical design which images the LCD panel onto the surface of interest, to provide for arrangements and assembly of particles in such patterns.